Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/055

ASSESSMENT OF THE GREEN SEA URCHIN FISHERY IN THE ESTUARY AND THE GULF OF ST. LAWRENCE IN 2011

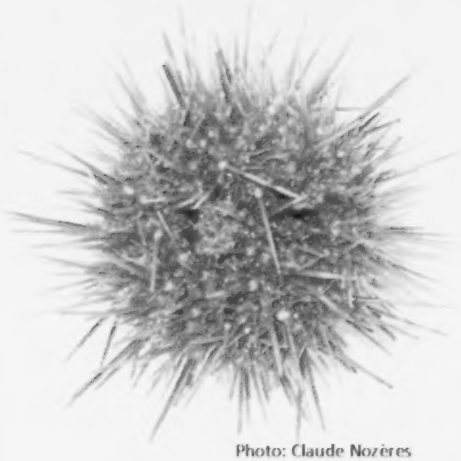

Photo: Claude Nozères

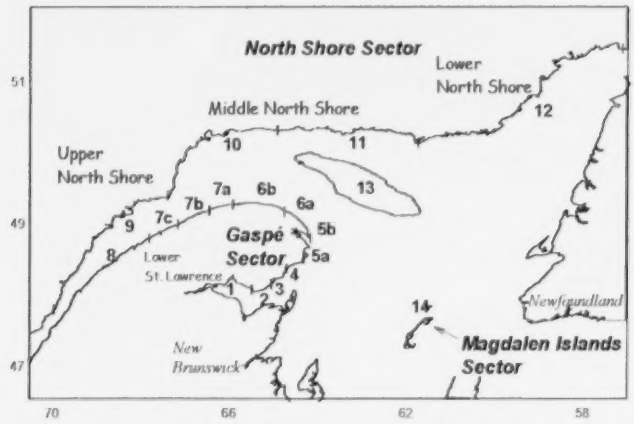

Figure 1: Green Sea Urchin Management Areas in the Estuary and the Gulf of St. Lawrence

Context

Commercial fishing of the green sea urchin (Strongylocentrotus droebachiensis) in the Estuary and the northern Gulf of St. Lawrence began in 1991. Fourteen areas have been created (Figure 1); however, many are still unfished or underutilized. Although trap fishing is permitted, most fisheries practice dive fishing. Management measures in effect are as follows: a limited number of licences per area, a minimum catch size of 50 mm in diameter and dive fishing seasons generally set from the end of March to the end of December. Harvesting takes place once the ice cover opens up and the gonad yield increases, that is, from the end of March to May and from September to December.

Fishing effort was concentrated in Areas 8 and 9 in the St. Lawrence Estuary. Green sea urchin landings in Quebec fluctuated between 7 and 187 tonnes (t) until 2005, when they jumped to 684 t and 762 t in 2006 and 2007, respectively. This was primarily due to the increase in fishing effort at the mouth of the Saguenay in Area 9.

The resource is assessed every three years to determine whether changes to the stock status of the resource necessitate adjustments to the conservation approach or management plan. The last assessment of this fishery dates back to 2008 and mainly targeted Area 9 on Quebec's North Shore, where the vast majority of catches were made. This report focuses primarily on Areas 8 and 9, and is based on the Regional Advisory Meeting of Fisheries and Oceans Canada's Canadian Science Advisory Secretariat held on June 7, 2012, which related to the Assessment of the Green Sea Urchin Fishery in the Estuary and Northern Gulf of St. Lawrence in 2011.

Canada

SUMMARY

- Annual green sea urchin landings in Quebec were sporadic and generally low (< 150 t) until 2002. Since 2003, they have been steady at over 340 t and peaked at 762 t in 2007. Although landings have been reported for Areas 3, 7, 10, 11, 12 and 14 since 1991, they have either been intermittent or insignificant. Over 98% of landings cumulated since 2003 originate from Areas 8 and 9.

Area 9

- Harvesting is currently concentrated at the mouth of the Saguenay; however, there are significant variations in the spatial distribution of fishing effort and yields within this sector. This is a healthy situation because effort has stabilized to an acceptable level and landings and CPUEs are increasing. It would be a good idea to continue to use the measures currently in place.

Area 8

- This area was traditionally harvested at the eastern tip of Île Verte and, since 2008, from the southeastern side of the eastern tip of Île aux Lièvres and of Battures de l'Île Blanche. Fishing effort has increased significantly in recent years, primarily due to increased harvesting at Île aux Lièvres. This decreased, however, in 2011.

- Landings from Île Verte fluctuated over the last four years, while those from Île aux Lièvres increased significantly from 2008 to 2010, and then decreased in 2011 to a level similar to that reported in 2009. The drop in annual CPUE (measured in kg/diver-hour) from 2007-2008 to 2011 is largely due to a decrease in diver performance at Île aux Lièvres (-48%) since 2008. Diver performance at Île Verte is variable, with no apparent trend. The mean size of landed sea urchins has varied over the years; however, there is no apparent trend with respect to fishing area or site.

- At Île aux Lièvres, the decrease in diver performance and the seemingly high harvest rate in the area fished are consistent and suggest that the mean catch level in this area since 2008 is not sustainable. Catch reduction is recommended. Furthermore, as the beds harvested south of Île aux Lièvres are partially reliant on the sea urchin population north of the island, any significant fishing development in the north could reduce the biomass available in the south. At Île Verte, inconsistent diver performance over the past several years seems to indicate that the sea urchin population is withstanding the fishing pressure it is under and suggests that the mean catch level for this area is sustainable.

INTRODUCTION

Species biology

Green sea urchins have separate sexes that cannot be distinguished based on external characteristics. It is the gonads that are sought and male and female sea urchins are caught indiscriminately in this fishery. The five gonads undergo significant changes in volume, firmness and colour over an annual reproductive cycle. In winter, gonad weight may account for as much as 25% of the sea urchin's total weight. During spawning, in May or June in the St. Lawrence

Estuary, gonad weight drops below 10% of the urchin's total weight and remains low throughout the summer. The commercial value of sea urchins decreases during this time period. However, with the arrival of fall, gonad weight increases once again, restoring the species' commercial value.

The green sea urchin reaches sexual maturity at a test diameter of around 25 to 30 mm and at an age of around 3 to 4 years old. Fertilization is external and produces pelagic larvae that drift for about one to four months in the surface water and then settle on the bottom. At the time of settlement, the juvenile sea urchin measures barely 0.5 mm in diameter. It reaches the minimum legal size of 50 mm at around 5 to 7 years of age and can live several more decades. Sea urchin growth rate may vary considerably and depends more on the quality and quantity of available food than on temperature or season. The sea urchin grows more rapidly along kelp beds, or in areas where currents bring a regular supply of algae, than on barren substrates.

In more favourable areas, the green sea urchin forms feeding fronts or high-density aggregates and strips the algae from the substrate. When the larger sea urchins are removed from feeding fronts, they may be replaced by sublegal-size sea urchins already present in the area and by legal-size sea urchins that have migrated from deeper waters.

The green sea urchin survival rate, excluding harvesting, is usually quite high. The main causes of natural mortality for the sea urchin are osmotic stress, predation and disease. Larvae and juveniles are especially sensitive to low salinity. It has been suggested that recruitment in the Quebec Region could be episodic due to unfavourable salinity conditions that sometimes impact larval survival, particularly in the middle estuary (Île d'Orléans to the mouth of the Saguenay) and to a lesser extent further downstream. Along the Quebec coastline, the main green sea urchin predators include lobster, crab, large starfish, wolfish, and seabirds.

Description of the fishery

The Quebec coastline is divided into 14 main green sea urchin fishing areas. Areas 9 to 12 of the North Shore sector are much larger than the Gaspé sector areas (Figure 1). This report focuses primarily on Areas 8 and 9. Area 8 extends from Île d'Orléans to Les Boules, while Area 9 extends from Pointe-au-Pic to Pointe des Monts. Since 2010, sub-area 9-1 has been delineated at the mouth of the Saguenay to better contain major fishing activities in the area.

There are two authorized methods for harvesting green sea urchins in the Quebec region: underwater diving and whelk traps. Trap fishing is not very popular and is mostly performed in Area 9. Towed harvesting gear is prohibited except in sea urchin rearing sites along the Lower St. Lawrence coastline between Trois-Pistoles and Rimouski (Area 8) where the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec has approved its use.

The management measures in effect for green sea urchins in the Quebec region are aimed at controlling fishing effort and protecting reproductive potential. There are a limited number of exploratory licenses, divers and traps for each fishing area. A minimum legal size of 50 mm test diameter is mandatory everywhere. Underwater diving for sea urchins is permitted almost all the time, but the use of traps is usually prohibited from spring to fall.

Logbooks are mandatory in the Quebec region. These logbooks indicate the duration of the fishing trips and the landings, the harvesting method, the locations where catches were made

and, if applicable, the number of divers or traps and their immersion time, as well as the duration, depth and composition of the sea floor at each dive.

There are seven licenses in Area 9, five of which have been permanent since 2009. Those with permanent licenses have exclusive use of sub-area 9-1, but are limited to a total of 80 vessel-days of fishing. They are also entitled to unlimited fishing in the rest of Area 9, with the exception of sectors 9A, 9B and 9D, where sea urchin fishing is prohibited in order to offer amateur recreational scuba-divers a better experience. Two exploratory licenses may be issued for trap fishing, but these have not been active since 2001. The maximum number of divers per license is four; however, only three can be in the water with one on stand-by aboard the vessel. The number of traps (maximum volume of 0.5 m^3, minimum mesh size of 102 mm with mandatory escape vents) is limited to 100 per vessel. In 2011, harvesting via underwater diving was authorized from March 26 to December 31. The use of traps was prohibited from April 1 to September 23.

Only two fisheries are active in Area 8. The number of divers is limited to five per vessel and they can harvest at the same time. There are no licenses issued for trap fishing.

The first green sea urchin landings in Quebec occurred in 1991 (Figure 2) near Havre-Saint-Pierre. From 6.7 t that year, landings fluctuated until they attained 187 t in 2005, then peaked at 762 t in 2007, and eventually leveled off at about 600 t between 2010 and 2011. Over 98% of the landings made in all of Quebec are from Areas 8 and 9 alone.

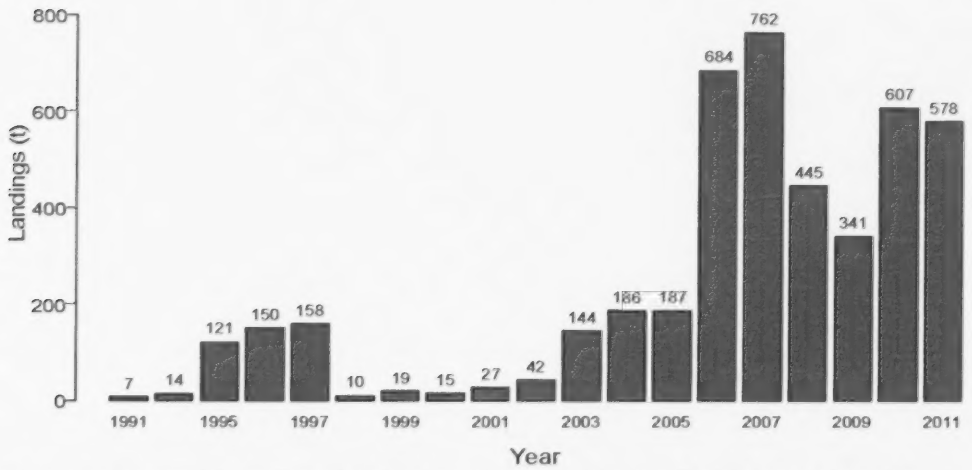

Figure 2. Green sea urchin landings for all areas in Quebec, starting in 1991. The 2011 data is preliminary.

ASSESSMENT OF THE RESOURCE IN AREAS 8 AND 9

The status of the resource in Areas 8 and 9 was established by examining various commercial fishery indicators. These indicators provide information on spatial distribution, fishing effort and success, as well as green sea urchin abundance and size. Moreover, underwater diving research surveys were conducted in sub-area 9-1 in the summers of 2008 and 2010, and in Area 8 in the summer of 2011 between Île aux Lièvres and Île Blanche.

Commercial fishery statistics are used for estimating fishing effort and for calculating catches per unit effort (CPUEs). Effort and CPUE are first given in diver-hours (dh) and in kilograms per diver-hour (kg/dh) because this has been the principal harvesting method in recent years (> 85% of landings) and is a better indicator of sea urchin abundance. A second rating in vessel-days (vd) and in kilograms per vessel-day (kg/vd) is also calculated because effort (number and duration of dives) is not always recorded.

As there are only two stakeholders in Area 8, the landing and effort graphs are presented in such a way that confidential information on these fisheries is not revealed. The landing and effort graphs' vertical axis scales have therefore been removed.

Area 9 resource status

Landings

Area 9 was assessed in 2008 (DFO, 2008). Landings in this area quickly decreased from 89 t in 1996 to between 1 and 14 t by 2002, and then increased to 140 t in 2005 (Figure 3). From then on, harvesting has concentrated almost solely on sub-area 9-1 at the mouth of the Saguenay, specifically at Batture aux Alouettes, even though the area of the seafloor is only 1.67 km^2. There was a significant increase in effort in 2006 and landings reached 600 t that year and 691 t the following year. There were seasonal closures in 2008 and 2009. Beginning in 2010, the following corrective measures were taken: sub-area 9-1 was created, encompassing Batture aux Alouettes, Baie Sainte-Catherine and Batture de la Pointe aux Vaches; licenses were limited to five stakeholders with catch history; licenses can be sold only within this group to prevent the addition of new fishers; and fishing effort control was set at 80 vd. These measures made it possible to decrease landings to 249 t in 2008, and to 154 t in 2009. They started rising in 2010 and again in 2011 up to 400 t.

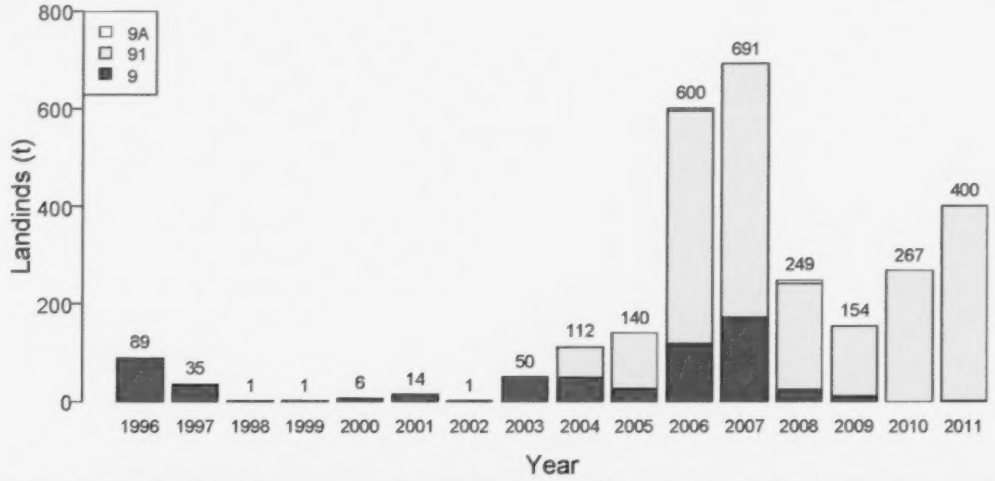

Figure 3. Green sea urchin landings in Area 9 from 1996 to 2011. Sub-area 9-1 has only existed since 2010; however, part of this sub-area is indicated for previous years to show its significance compared to the rest of Area 9. The numbers indicate the total landings in Area 9 for the corresponding year.

Fishing effort

From 1996 to 2004, fisheries primarily harvested sites near Forestville and Saint-Siméon. Baie Sainte-Catherine was explored in 2004, and Batture de la Pointe aux Vaches and Baie Sainte-Catherine were harvested in 2005. Figure 4 shows the distribution of georeferenced positions provided by purchase slips from recent fishing years. These three sectors at the mouth of the Saguenay would eventually be regrouped to form sub-area 9-1. From 2005 to 2011, harvesting was primarily concentrated on the beds of Batture aux Alouettes (sub-area 9-1), where 76 to 100% of dh were spent. The significant increase in fishing effort observed from 2004 to 2007 (DFO, 2008) led to a seasonal closure in 2008 and in 2009, as well as enhanced monitoring and surveillance. A stabilization in the fishing effort measured in vd is noted in 2010 and 2011 because an 80 vd limit was set (Figure 5). Effort measured in dh has been increasing gradually since 2009.

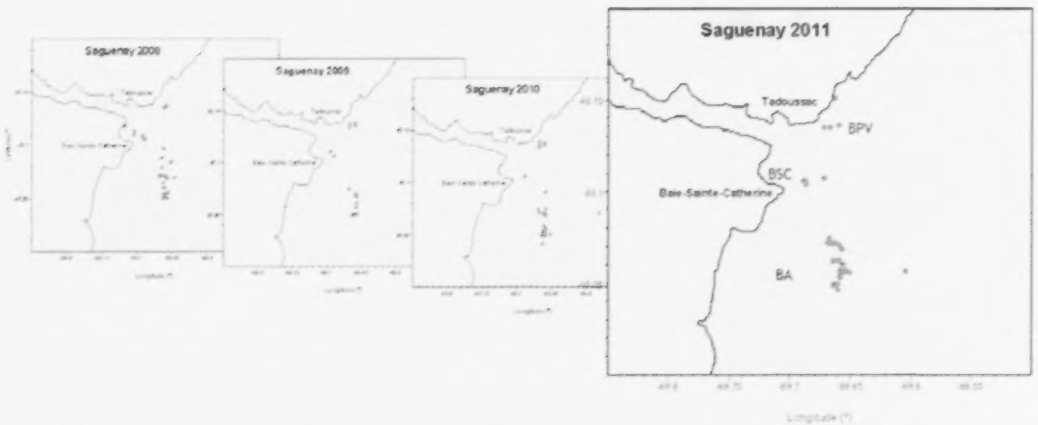

Figure 4. Distribution of fishing effort from 2008 to 2011 in sub-area 9-1 at the mouth of the Saguenay. BA = Batture aux Alouettes; BPV = Batture de la Pointe aux Vaches; BSC = Baie Sainte-Catherine.

The 80 vd limit proved to be extremely effective in reducing landings to a more reasonable level. Despite the fewer number of vd since this measure was adopted, the number of dh increased by 23% from 2010 to 2011, rising from 651 to 842 dh, which suggests that fisheries have been able to optimize their trips.

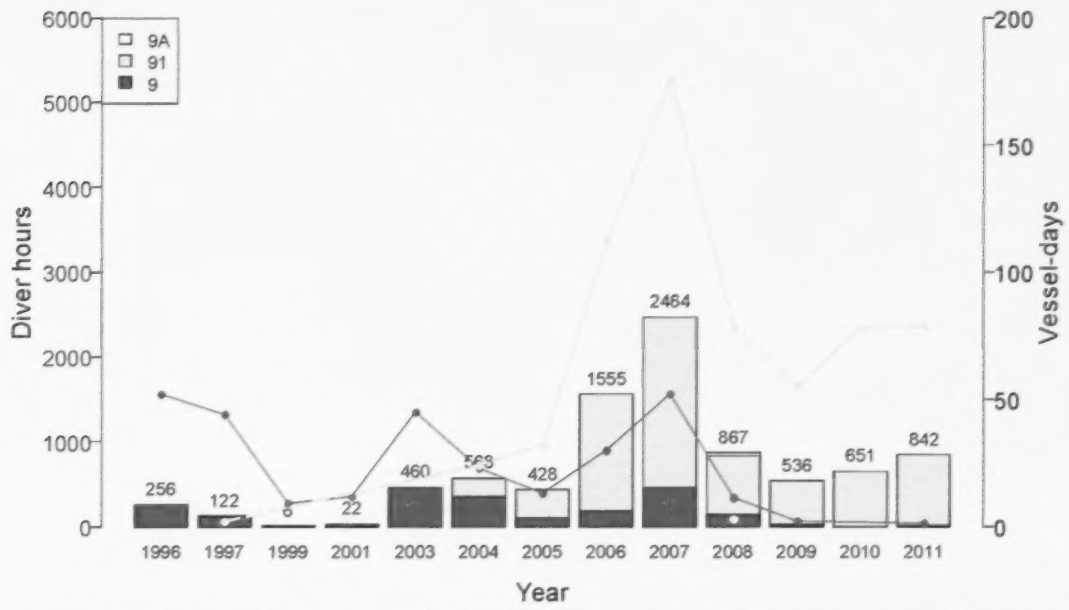

Figure 5. Green sea urchin fishing effort in Area 9 measured in dh (histogram) and in vd (dash line = sub-area 9-1, solid line = Area 9, excluding 9-1 and 9A) at the mouth of the Saguenay (sub-area 9-1), in sector 9A, which is now closed, and in the western and eastern portions of Area 9 from 1996 to 2011. The numbers shown above the bars indicate the total effort in Area 9 for the corresponding year. The single point that appears in the 2008 bar is the only effort recorded for sector 9A.

Catches per unit effort (CPUEs)

Following the decline of CPUEs from 2005 to 2007, the corrective actions taken in sub-area 9-1 in the fall of 2008, primarily based on a reduction in the number of days fished, appears to have been a determining factor in the significant improvement of CPUEs as of 2010, and in their peaking at 480 kg/dh in 2011 (Figure 6). This growth can be seen in each of the beds in sub-area 9-1. There are no discernible CPUE trends between the spring and the fall (Table 1). However, at 506.9 and 433.7 kg/dh, CPUEs from 2011 are far greater than the general mean of 329.1 kg/dh for the period from 2004 to 2010 (and the mean of 312.8 kg/dh calculated for the period from 2004 to 2008).

Fishing in Area 9 has therefore changed a great deal since the last assessment in 2008. Sectors 9A, 9B and 9D are now closed to fishing to focus on recreational scuba-diving and conservation activities, and commercial fishing is now almost exclusively concentrated in sub-area 9-1. The significant increase in CPUEs shown in Figure 6 can be attributed to the effectiveness of the corrective action taken for the 2009 season, unless there was strong recruitment during this period, as well.

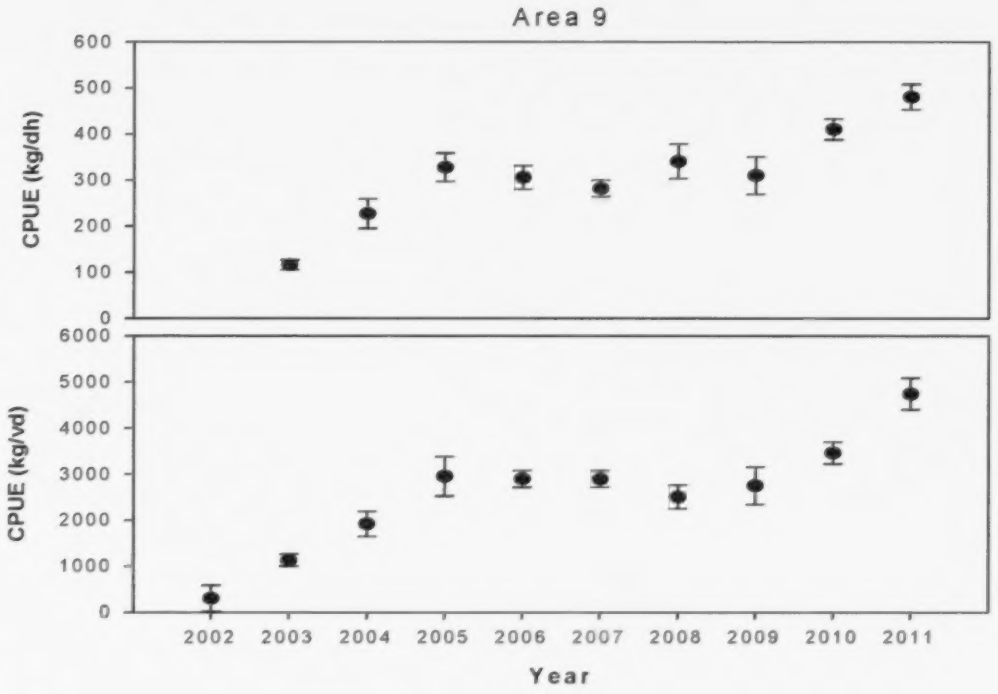

Figure 6. CPUE of green sea urchin in Area 9 measured in kg/dh and in kg/vd from 2002 to 2011.

Table 1. Mean (± one standard deviation, SD) of the CPUE measured in kg/dh for sub-area 9-1 in the spring and fall from 2008 to 2011, and in the spring of 2009, as well as the mean for all years from 2004 to 2011.

Sub-area 9-1		2008	2009	2010	2011	Mean 04-10
Spring	Mean (SD)	324.3 (129.7)	286.1 (51.6)	400.7 (68.6)	506.9 (78.7)	329.1
	% of total effort	99.8	100	82.1	72.6	
Fall	Mean (SD)	363.6		447.3 (94.0)	433.7 (96.5)	

Size structures

Commercial catches have been sampled in Area 9 over the past few years, primarily in sub-area 9-1, where most catches and landings take place. These samples represent sorted and landed sea urchins. The mean size is relatively consistent from one year to the next, despite a variation in the minimum and maximum sizes (Figure 7).

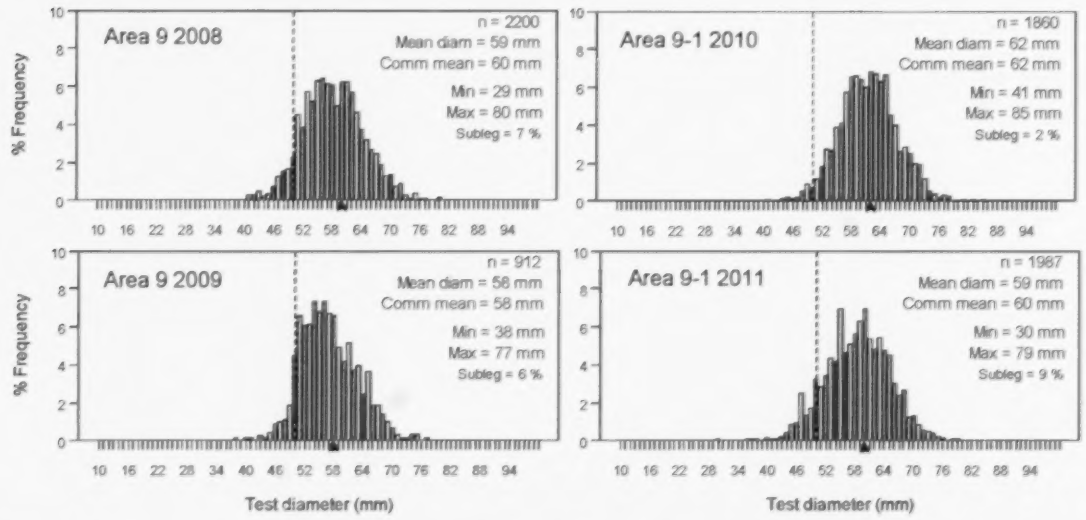

Figure 7. Green sea urchin size structures from sub-area 9-1 based on commercial sampling from 2009 to 2011, and likely from 2008 as well but there was no indication of the source in the database. Number (n), mean diameter (Mean diam), minimum size (Min.) and maximum size (Max.) are based on all sea urchins landed, while the mean commercial size (Comm mean.) is based solely on the upper portion of the 50 mm diameter legal size. The percentage of sublegal-size individuals (Subleg) is indicated. The dotted line represents the minimum legal size.

This variation in minimum and maximum sizes and the increase in CPUEs may suggest the arrival and migration of new cohorts of sea urchin. The relative stability of the median-sized individuals indicates that the local growth or the migration of individuals populating peripheral sites compensated for the sea urchin harvest. At 9% in 2011, the proportion of sublegal-size individuals was very high and will require better sorting at sea. It is difficult to explain the presence of individuals as small as 29 mm in commercial landings where the minimum legal size is set at 50 mm.

Underwater research surveys

The first underwater survey was conducted in the summer of 2008 in sub-area 9-1 and concentrated on Batture aux Alouettes (Sainte-Marie et al., 2012), while the second survey was conducted in 2010 and included Baie Sainte-Catherine and Batture de la Pointe aux Vaches, as well. During these surveys, divers created 100 m-long transects perpendicular to the low tide line on which they sampled one quadrant of 0.25, 0.5 or 1 m^2 every 20 m. These surveys revealed higher concentrations of sea urchins of all sizes offshore than on feeding fronts; however, there were higher concentrations of legal-size individuals in the trenches of Batture aux Alouettes and at the front of Batture de la Pointe aux Vaches (mean > 40 individuals or 3.5 kg per m^2 in 2010). On these sites, a significant 2009 year-class was noted during the 2010 survey and could be

recruited to the fishery between 2014 and 2016. The biomass of legal-size sea urchins on the Batture aux Alouettes fishing grounds was lower in 2010 than in 2008, while the density of sea urchins at the periphery of the Batture aux Alouettes fishing grounds was higher in 2010 than in 2008, suggesting that recruitment to the population is stable and is provided by the numerous individuals already present on the vast peripheral bodies of the areas currently harvested. Annual harvest of sea urchins since 2009 in the Batture aux Alouettes fishing area appear low (about 5%) when compared to the biomass of the legal-size sea urchins found there in 2008 and 2010.

Area 8 resource status

Landings

Area 8 was very briefly assessed in 2000 (DFO, 2000). Landings in this area show a nearly constant increase since 2004, the first year in which fishing positions allowed fishers to better locate catches (Figure 8). However, fishing information from before 2008 must be treated with caution due to the fact that few logbooks were submitted. Only two small sectors of this area were traditionally harvested: the eastern tip of Île Verte, and more recently, the southeastern side of Île aux Lièvres and southwest of Batture de l'Île Blanche. Landings from Île Verte have fluctuated over the past four years, while those from Île aux Lièvres increased significantly from 2008 to 2011, and decreased to a level similar to that of 2009 in 2011.

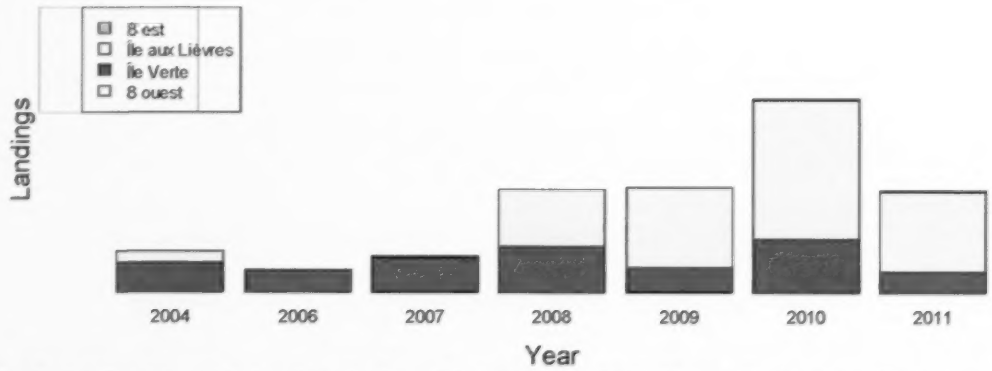

Figure 8. Green sea urchin landings in Area 8 from 2004 to 2011. The vertical axis scale presenting the units of landings of sea urchins is not shown in order to keep the results of the two fishers that are active in this area confidential.

Fishing effort

Area 8, from the south side of Île Blanche or Île aux Lièvres, did not start being harvested until 2008, even though fishers from Area 9 have been visiting the north side since 2003 (Figure 9). Based on the available information, Île Verte has also been visited since 2004; however, as only some logbooks are available for the years prior to 2008, this sector may have been harvested even earlier. Based on the data in Figure 10, fishing effort has increased significantly in the last four years, even though there was a declinein 2011. This increase is largely due to the fact that the Île aux Lièvres area began being harvested during this time.

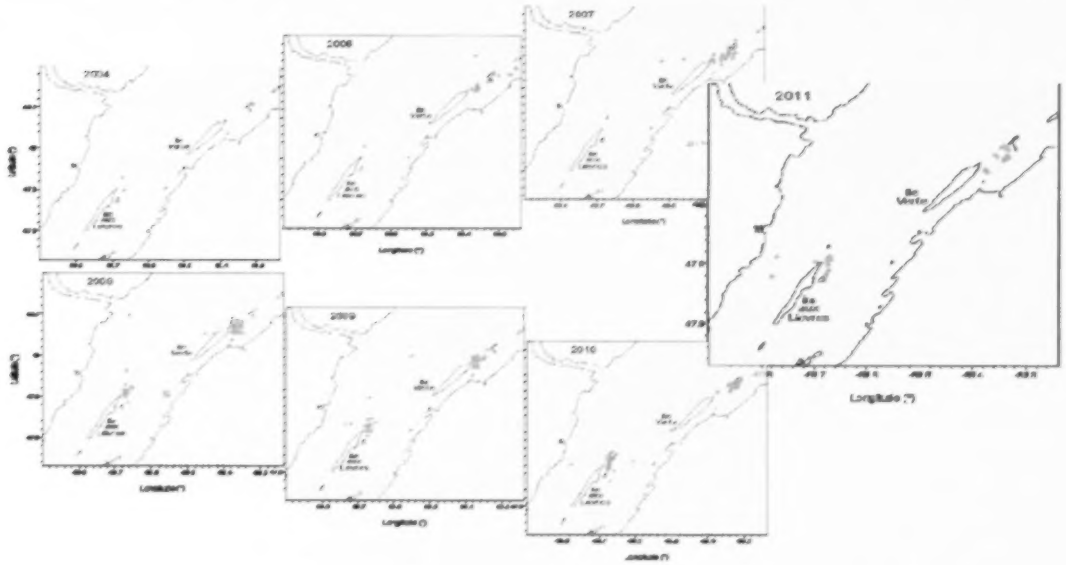

Figure 9. Distribution of fishing effort from 2004 to 2011 in Area 8, concentrated near Île Verte and Île aux Lièvres.

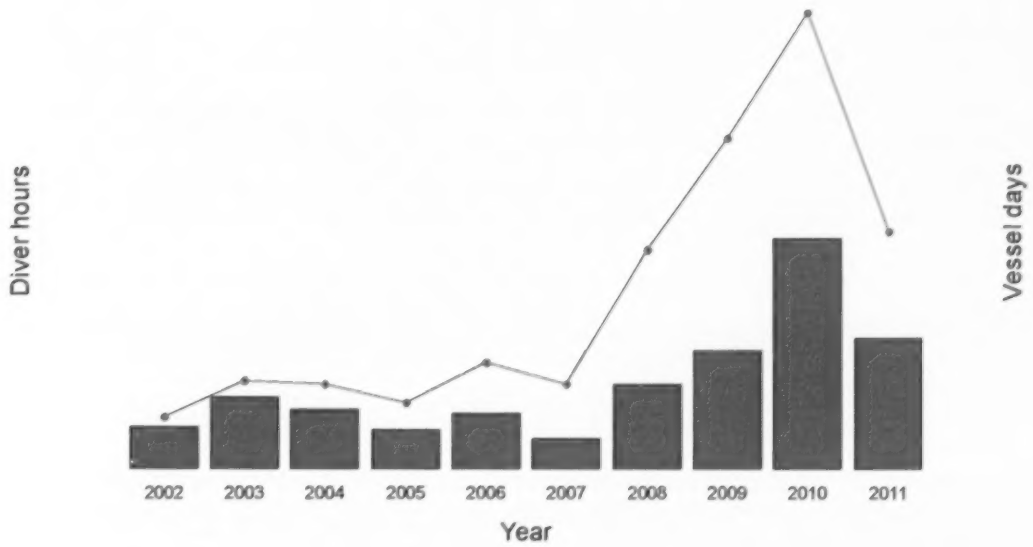

Figure 10. Green sea urchin fishing effort in Area 8 measured in dh (histogram) and in vd (line) from 2002 to 2011. The vertical axis scales presenting the units of effort are not shown in order to keep the results of the two fishers who are active in this area confidential.

Catches per unit effort (CPUEs)

After four relatively stable years from 2002 to 2005, CPUEs (in kg/dh) for the entire area underwent a significant increase until 2007 to 2008, when they decreased until 2011 to a similar

value to that obtained in 2002 (Figure 11). Activities at Île aux Lièvres did not start until 2008; however, CPUEs underwent a 48% decrease, following the same downward trend as that observed throughout the area in subsequent years. CPUEs for Île Verte are somewhat inconsistent from year to year but, they do show a drop in 2011, which exacerbates the decrease of the mean CPUE for all of Area 8.

CPUEs for Île aux Lièvres were higher than those for Île Verte until 2009; however, the situation then reversed itself. The average yields observed for Île Verte remained close to the mean for the entire area, while recent yields for Île aux Lièvres have decreased significantly, dropping to well below the mean in 2011.

Size structures

Recent commercial catch samples are available for the two most harvested sectors of Area 8, with the exception of 2008, when the area was not covered (Figure 12). These samples represent sea urchins that were sorted and landed at the wharf. The mean size of sea urchins from Île Verte is slightly larger than those from Île aux Lièvres, with the exception of those from 2010. The mean size of those from Île Verte decreased in 2010, but in 2011 they reverted to the values recorded from 2006 to 2009, increasing to the maximum size at the same time. In general, there are very few individuals of sublegal size (≤ 3%) at either location.

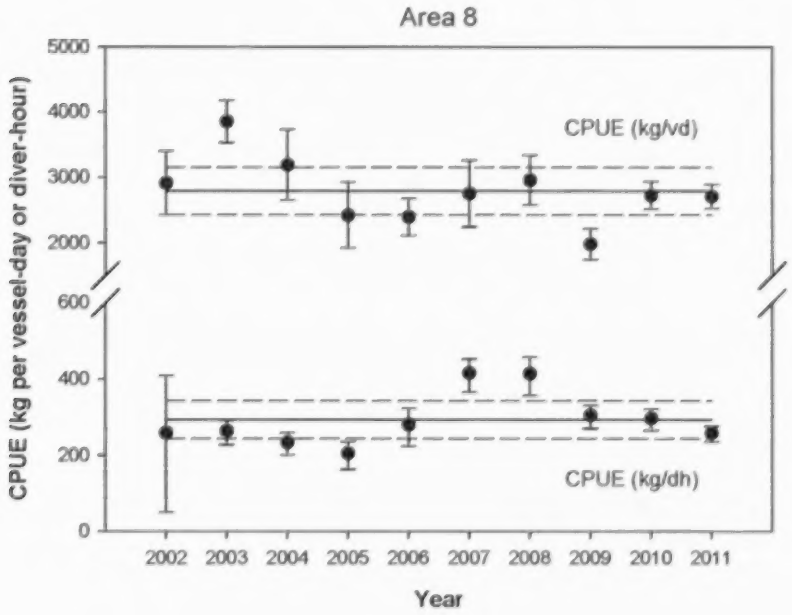

Figure 11. Mean and SD for CPUE of green sea urchin in Area 8 measured in kg/dh and in kg/vd from 2002 to 2011.

Underwater research surveys

A photograph research survey was conducted at Île aux Lièvres in the summer of 2011. The survey revealed a dense group of legal-size sea urchins (> 20 individuals/m^2) at a depth of under 15 m in most of the transects on the northwest side of the islands (Area 9). This side of the islands has not yet been targeted for harvesting. Groups of legal-size sea urchins are generally less dense on the southwest side of the islands, with the exception of the main harvesting area (0.79 km^2). This area, which is centered on the southeast mouth of the passage between the two islands, is quite shallow, but rich in kelp. Given the very strong tidal currents in the area and the predominance of storms and winds from the west, the greater density and mean size of the sea urchins in the harvesting area may be explained by their occasional migration from the north to the south, or by greater growth due to enrichment provided by drifting algae. The biomass of the legal-size sea urchins in the harvesting area was estimated at 1 213 t, and samples from 2008 to 2011 represented between 12 and 19% of this biomass, an amount considered too high.

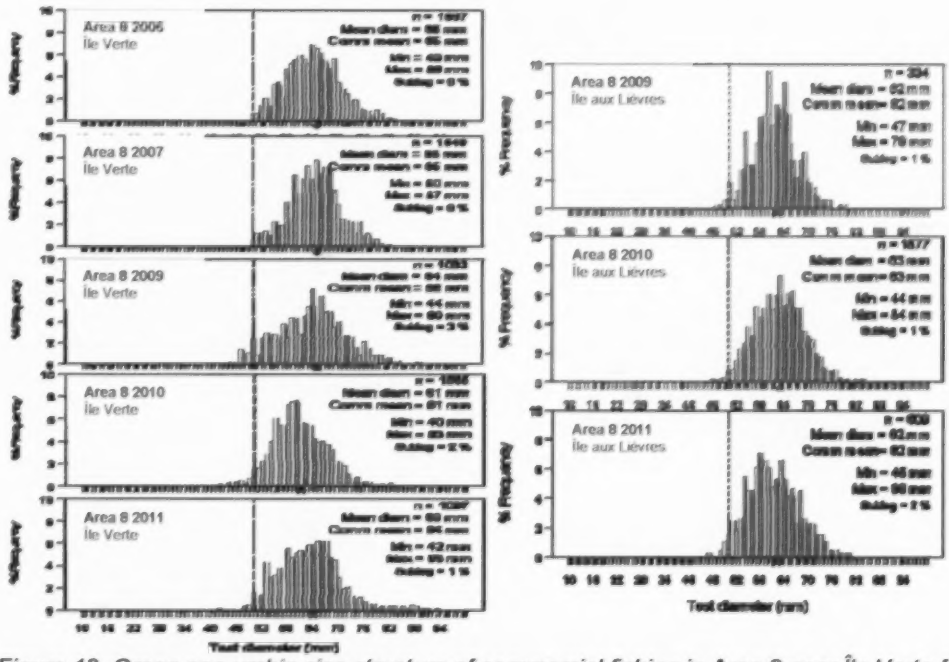

Figure 12. Green sea urchin size structure of commercial fishing in Area 8 near Île Verte from 2006 to 2011 and at Île aux Lièvres from 2009 to 2011. Number (n), mean diameter (Meandiam), minimum size (Min.) and maximum size (Max.) are extracted based on all of the sea urchins landed, while the mean commercial size (Comm mean.) is based solely onindividuals exceeding the legal size of 50 mm in diameter. The percentage of sublegal-size individuals (Subleg) is indicated. The dotted line represents the minimum legal size.

Sources of uncertainty

In the short term, the information that would be most valuable in providing a better understanding of the dynamic of the green sea urchin would be generated through an assessment of the age structure of landed urchins and of the population as a whole. There are methods for evaluating the age of sea urchins from the calcareous plates of the test or Aristotle's lantern. This information

would provide a way to measure growth rates and determine temporal patterns of recruitment . Green sea urchin recruitment is likely dependant on salinity conditions in the estuary and may be increasingly more sporadic moving upstream from Pointe-des-Monts into the St. Lawrence.

Studying the movements of sea urchins around harvested areas is very useful in providing a better understanding of the significance of migration versus growth for replacing sea urchins on the harvested seafloor. It would be especially interesting to inventory sinks (that sea urchins enter but do not exit) and the ways in which replenishment alters the density and distribution of neighbouring sea urchins.

The spatial variability of sea urchin gonad quality is still unknown within the main harvesting areas. Therefore, although underwater surveys suggest the presence of certain areas in which sea urchin populations are abundant, only some may be of sufficient quality to be harvested. We know that sea urchins that do not have access to kelp in their diet have gonads of lesser quality. However, the time required in nature to condition gonads following the migration of a sea urchin on an area of the seafloor rich in nutrients is still unknown. Sea urchin quality may also vary based on their position in the feeding front.

It would also be important to examine the indirect mortality of sublegal or legal-size sea urchins linked to harvesting activities. Catches are sorted at sea on a grid to eliminate sublegal-size individuals. In addition, legal-size sea urchins are sometimes thrown back to the sea if their gonads are not of sufficient quality. The survival of sea urchins that have been thrown back might depend on sorting conditions, the location where the sorting occurred and where they were thrown back.

Finally, it would be important to establish specific mass-diameter relationships for the green sea urchin at the main sites harvested for the different seasons of the year.

CONCLUSION

Area 9-1. The situation is healthy. Controlling the fishing effort fostered an increase in the biomass of commercial urchins, and in yields and landings.

Area 8. At Île aux Lièvres, the decrease in diver performance and the seemingly high harvest rate in the harvested area are consistent and suggest that the mean catch level in this area since 2008 is not sustainable. Catch reduction is recommended. Furthermore, as the beds harvested south of Île aux Lièvres are partially reliant on the sea urchin population north of the island, any significant fishing development in the north could reduce the biomass available in the south. At Île Verte, inconsistent diver performance over the past several years seems to indicate that the sea urchin population is withstanding the fishing pressure it is under and suggests that the mean catch level for this area is sustainable.

OTHER CONSIDERATIONS

Harvesting via underwater diving is not considered harmful for the environment. However, the green sea urchin is a structuring organism in the ecosystem and when it is abundant, it can determine the nature and diversity of benthic communities in shallow waters. Severe green sea urchin population depletion, either from disease or harvesting, can therefore lead to significant changes in the coastal ecosystem. In addition, certain seabirds could depend in part on the green sea urchin for their diet.

Recruitment in very dynamic systems, such as Area 9-1 and Île aux Lièvres, may depend on the growth rate of sea urchins on fishing grounds, the migration rate of sea urchins pre-recruited and recruited from peripheral areas (including the northwest side of Île aux Lièvres) to fishing grounds that foster high growth, and possibly storms that bring or eliminate the largest urchins, specifically. Effort control (vd quota, limit on the number of divers per boat, limit on extraction technology) appears well-adapted to ensure harvesting of the resource.

SOURCES OF INFORMATION

This Science Advisory Report is from the meeting of June 7, 2012, on the Assessment of the Green Sea Urchin Fishery in the Estuary and Northern Gulf of St. Lawrence in 2011. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

DFO. 2000. Green sea urchin of the inshore waters of Quebec. DFO – Science, Stock Status Reports C4-13 (2000).

DFO. 2008. Assessment of green sea urchin of the North Shore of the St. Lawrence Estuary in 2008. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/048.

Sainte-Marie, B., Brillon, S. et Paille, N. 2012. Évaluation de l'oursin vert de la côte nord de l'estuaire du Saint-Laurent en 2008. Secr. can. de consult. sci. du MPO. Doc. de rech. 2012/088. iii + 30 p.

FOR MORE INFORMATION

Contact: Jean-Paul Dallaire
Maurice Lamontagne Institute
850 route de la Mer
P.O. Box 1000
Mont-Joli, QC
G5H 3Z4

Telephone: 418-775-0576
Fax: 418-775-0740
E-mail: Jean-Paul.Dallaire@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
850 Route de la Mer
Mont-Joli, QC

Telephone: 418-775-0825
Fax: 418-775-0679
Email: bras@dfo-mpo.gc.ca
Website: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
© Her Majesty the Queen in Right of Canada, 2012

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION:

DFO. 2012. Assessment of the Green Sea Urchin Fishery in the Estuary and the Gulf of St. Lawrence in 2011. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/055.